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DEXTER S. KIMBALL

President, S. P. E. E., 1928–29

DEXTER SIMPSON KIMBALL, PRESIDENT OF THE SOCIETY

Dexter Simpson Kimball was born in New River, New Brunswick, Canada, October 21, 1865. He received his A.B. in Engineering at the Leland Stanford Junior University in 1896, and the M.E. in 1913. In 1926, the University of Rochester, N. Y., conferred the degree of LL.D. on him.

Dean Kimball began his career as an apprentice and journeymen with Pope and Talbot, in Port Gamble, Wash., in 1881, leaving there in 1887 to work in the shops of the Union Iron Works in San Francisco, and in 1896 entered the engineering department. He also became designing engineer for the Anaconda Mining Company. He was Assistant Professor of Machine Design from 1898 to 1901 when he became Works Manager for the Stanley Electric Manufacturing Company at Pittsfield, Mass. In 1904 Dean Kimball returned to Cornell as Professor of Machine Design and Construction. In 1915 he became Professor of Industrial Engineering, which title he still carries. He was Acting President during 1918 and has been Dean of the College of Engineering since 1920.

Dean Kimball was President of the American Engineering Council for two years, 1926–28. He was Chairman of the organizing committee of the Second Pan-American Standardization Conference in 1927. He is a member of Sigma Xi and Tau Beta Pi.

President Kimball is the author of many textbooks, among which are "Elements of Machine Design," "Industrial Education," "Principles of Industrial Organization," "Elements of Cost Finding," and "Plant Management."

He has been a member of the Society for the Promotion of Engineering Education since 1915.

WHY ATTEND MEETINGS?

F. L. BISHOP

Secretary

Why should anyone take the time to attend meetings, and especially those of the Society for the Promotion of Engineering Education?

The answer to that question is simply "contact." Contact is one of the most important words in the language. Contact is the basis of the best in education, and you want the best. Education filters through personality. The contacts which you make at a meeting may mean that a light will steal upon you, faintly but steadily as the dawn. Or "it may illuminate you like the white light of the Damascus road. Your soul is set aglow by the candle of another life, and you become something that you never were before. And you will never be the same again." Then you will think:

Why do so many members attend our annual meetings? It is a pleasant trip and you meet so many interesting people—people with whom you have much in common and with whom you like to talk. The addresses and reports are real contributions to engineering education and the discussions are valuable, especially those discussions which are carried on after the regular meetings when small groups get together and talk things over. It is time and money well invested, and you know that you have learned some things which can not be found in any book.

Attend the thirty-seventh annual meeting of the Society at The Ohio State University, Columbus, Ohio, June 19–21, 1929, and find out for yourself the meaning of that word "contact."

REPORT OF COMMITTEE NO. 15—CIVIL ENGINEERING, JUNE, 1929

THE COORDINATION OF SURVEYING AS TAUGHT IN COLLEGES AND AS USED IN PRACTICE

Surveying has always been regarded as the traditional background of a C.E. curriculum and has long occupied a prominent place therein. But in the swing from the old time undergraduate curriculum, loaded with technical courses, to a more general one in which the emphasis is placed upon the study of basic principles underlying all engineering, in which English, economics, language, etc., are admitted upon an equal footing with science and technology the strictly technical studies have come in for a fresh scrutiny as to their real value and place in the four year curriculum. The trend of the time is certainly away from a high degree of specialization, and it is now believed by many that some of the engineering studies formerly given in the four year undergraduate course may now more properly be reserved for the graduate work. Because of its strongly intrenched position in the C.E. curriculum and the amount of time generally allocated to its study, surveying, especially, has more and more felt the pressure from the outside and is more than ever put upon the defensive to prove its place in the four year curriculum.

The committee has taken note of a previous investigation which gives recognition to this problem. It is a summary of inquiries by committees of five national engineering societies entitled "Opinions of Professional Engineers concerning Educational Policies and Practices," published in the JOURNAL OF ENGINEERING EDUCATION for December, 1927. In a chart on page 253, plane surveying is accorded greater emphasis as a definite requirement for the civil engineering curriculum than any other one subject.

The committee, then, felt that it could not do better, at this time, than to make a survey of surveying, and that, further,

the best way to proceed in its investigation was to consult as many of the employers of the young graduates, as possible, especially in the fields involving much surveying, such as highway and railway engineering. Accordingly the following letter and questionnaire were prepared. In framing the questions the committee realized that a consideration of surveying independent of its relation to the competitive coures would be valueless. If the questions seem too general, it is because no quantitative solution is possible. It was hoped that out of the data thus obtained a few guiding principles would be found, which each college could use in meeting its own special conditions.

The Letter

Dear Sir: You are doubtless familiar with the extensive study of engineering education which is being made through the Society for the Promotion of Engineering Education. Committee No. 15, of which I am chairman, has been assigned a small portion of this task, as indicated by the enclosed questionnaire.

If you would make, or secure from other members of your organization, a reply which would be representative of your experience and your judgment, you would give both assistance and encouragement in this study; you would therefore contribute to a more helpful understanding between the colleges and the employers of college men.

The committee trusts you will be willing to make this contribution.

Sincerely yours,

A. H. Fuller,
Chairman.

The Questionnaire

The Coordination of Surveying as Taught in Colleges and as Used in Practice

A request for data from the Committee of Civil Engineering of the Society for the Promotion of Engineering Education.

F. H. Constant, Princeton, University, Princeton, N. J.,
F. O. Dufour, Lafayette College, Easton, Pa.,
Horace Judd, Ohio State Univ., Columbus, Ohio,
J. R. Lapham, George Washington, Univ., Washington, D. C.,
A. H. Fuller, Chairman, Iowa State College, Ames, Iowa.

Dean Louis Mitchell, Syracuse University, was added to the committee after these questions were prepared.

* Presented at the 36th annual meeting of the Society, University of North Carolina, June 26–28, 1928.

The Committee asks your cooperation in an attempt to reach a better understanding than now exists between the college and the employers of college graduates in regard to the emphasis which should be given in college to surveying.

The motive back of the inquiry is to see what correlation exists or may exist between the preparation the colleges are giving or may give and the needs and requirements of the organizations into which the college men go for their first outside experience.

The benefit of your experience and your judgment would be helpful in proportion as you considered the ultimate value of the graduate in your organization as well as his initial adaptability. Further training in surveying would necessarily be given at the expense of more complete training in advanced engineering subjects, in economics, or in other subjects which would contribute to a broader education.

We would greatly appreciate your assistance in consideration of this problem whether it was given as a discussion or as replies to the following questions.

1. Do college graduates work to advantage in your organization

(*a*) during the first few weeks?
(*b*) after several years?

2. Would they be of greater value to you if they had more training in surveying and less training in advanced technical and in general subjects?

3. If so, what subjects do you believe should be given less emphasis?

(*a*) Advanced technical (railroads, highways, structural, sanitary, etc.).
(*b*) General (economics, psychology, history, English, foreign language, etc.).

4. Would they be of greater value to you if they had less training in surveying and more in advanced technical and general subjects?

5. If so, what subjects do you believe should be given greater emphasis?

(*a*) Advanced technical (railroads, highways, structural, sanitary, etc.).
(*b*) General (economics, psychology, history, English, foreign language, etc.).

6. Would you consider it practical to modify your present standards in breaking in college graduates to conform to either more or less college training in the theory or in the technique of surveying?

7. One reason for emphasizing the theory and the technique of surveying is that it is the first opportunity in a college course for the application of mathematics and drawing to an engineering subject. It is possible that these applications will provide desirable motivation and will create a background for better understanding of theory later in the course and therefore contribute economically to scholastic development.

Do you believe that this viewpoint is of sufficient importance to emphasize surveying in college beyond the point which is necessary for efficient work in surveying in your organization?

8. Will you check on the following list of phases of surveying the degree of proficiency which you consider the most economical for a college graduate in order to work and to develop to the best advantage in your organization. In checking, will you keep in mind questions 2, 4, 6 and 7.

Phases of Surveying	*None*	*Little*	*Medium*	*Much*
Chaining and rodding.				
Use of level and transit.				
Adjustments of level and transit.				
Stadia work.				
Plane table work.				
Sextant work.				
Astronomical work.				
a. Meridian from stars.				
b. Meridian from sun.				
c. Latitude.				
d. Longitude.				
e. Time.				
Note keeping.				
Plotting and mapping.				
Computations of area.				
Cross section work.				
Circular curves.				
Laying grade lines.				
Computation of earthwork.				
Emphasis on the proper degree of precision.				
Care of equipment.				

9. Have you been able to note any marked differences between men whose surveying had all been on a college campus and those who attended a "summer camp"?

If so, will you indicate the various distinctions you have noted, using another sheet or the back of this sheet if you need more space than is available here.

The Committee will greatly appreciate your replies and will acknowledge them. Will you mail them to:

A. H. FULLER,
Iowa State College,
Ames, Iowa.

The letter and questionnaire were sent, at first, to the Chief Engineer of each of the State Highway Commissions, many

of the railroads, the U. S. Coast and Geodetic Survey, the U. S. Geological Survey, the U. S. Reclamation Service and the Corps of Engineers U. S. Army.

The 64 responses to the first 98 letters contained, in addition to replies to the specific questions, some excellent discussions on the curriculum in general. The questions were then sent to about 25 organizations which employ large numbers of civil engineering graduates in lines of work where surveying is of minor importance. The 15 replies from these letters, together with the replies from the other letters, are given in part in Table 1 and in Figs. 1 to 5.

Discussion of Questions 1 to 7 and 9

The replies to questions 1 to 7 and 9 are given in tabular form in Table 1 and in graphic form in Fig. 1. They suggest the following discussion for each question:

Question 1.—44 per cent reported favorably and 56 per cent reported unfavorably upon the initial value of the college graduate to the organization, with about the same relation showing in the different fields when taken separately. All were unanimous in the opinion that after several years the college graduate was working to advantage.

Questions 2 and *4* are considered together. The Railways were against increasing the training in surveying at the expense of advanced technical and general subjects by a ratio of 3.5 to 1, the government organizations, by 2 to 1 and the miscellaneous by 13 to 1, while the Highways were in favor of more surveying by a ratio of 2 to 1. The total replies, showed 37 per cent, in favor of and 63 per cent against more surveying. On the other hand, the Railways were in favor of more technical and general training at the expense of surveying by a ratio of 3 to 2, the miscellaneous group by 5 to 1, the government organizations equally divided while the Highways were against an increase in technical and general training by a ratio of about 4 to 1. The total replies were about equally divided in regard to an increase in technical and general training at the expense of surveying.

TABLE 1

Replies to Questions 1–7 and 9

	1				2		3—Less Emphasis									4	
	a		*b*				*a*				*b*						
	Yes	No	Yes	No	Yes	No	Rr	Hy	Str	San	Ec	Psy	Hist	Engl	F.L.	Yes	No
Railways	11	14	24	0	6	21	1	1	0	2	3	5	6	3	6	15	10
Highways	13	17	31	0	19	9	5	3	3	5	7	7	7	4	10	5	19
U. S. Government Organizations	2	3	6	0	2	4	0	0	0	1	1	1	1	1	2	3	3
Miscellaneous	4	5	13	0	1	13	0	0	0	0	0	0	0	0	0	10	2
Total	30	39	74	0	28	47	6	4	3	8	11	13	14	8	18	33	34

	5—More Emphasis									6		7		9	
	a				*b*										
	Rr	Hyd	Str	San	Ec	Psy	Hist	Engl	F.L.	Yes	No	Yes	No	Yes	No
Railways	10	9	11	9	8	3	3	9	5	6	19	10	17	10	16
Highways	8	8	6	4	3	3	3	11	2	6	12	13	15	12	6
U. S. Government Organizations	0	0	2	0	4	0	0	4	2	2	4	—	5	1	2
Miscellaneous	1	1	5	2	7	1	1	4	1	2	10	0	8	2	7
Total	19	18	24	15	27	7	7	28	10	16	45	23	45	25	31

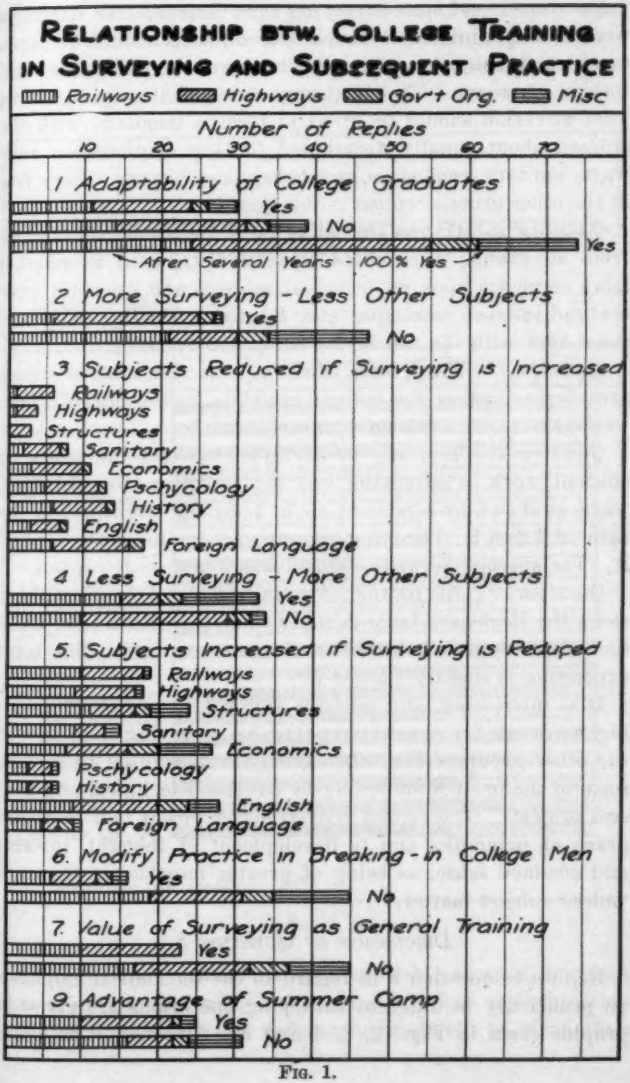

RELATIONSHIP BTW. COLLEGE TRAINING IN SURVEYING AND SUBSEQUENT PRACTICE
Railways
Highways
Gov't Org.
Misc
Number of Replies
10
20
30
40
50
60
70
1 Adaptability of College Graduates
Yes
No
Yes
After Several Years - 100% Yes
2 More Surveying - Less Other Subjects
Yes
No
3 Subjects Reduced if Surveying is Increased
Railways
Highways
Structures
Sanitary
Economics
Pschycology
History
English
Foreign Language
4 Less Surveying - More Other Subjects
Yes
No
5. Subjects Increased if Surveying is Reduced
Railways
Highways
Structures
Sanitary
Economics
Pschycology
History
English
Foreign Language
6. Modify Practice in Breaking-in College Men
Yes
No
7. Value of Surveying as General Training
Yes
No
9. Advantage of Summer Camp
Yes
No

FIG. 1.

Question 3.—If more surveying were desirable, the Railways were of the opinion that much less emphasis should be given to general subjects, especially to psychology, history and foreign language. The Highways were of the opinion that least attention should be given to foreign language with the opinion about equally distributed for less emphasis on railways, sanitary, economics, psychology and history. Very few in the other groups replied to this question.

Question 5.—If less surveying were desirable, the replies from all groups were about equally distributed in placing more emphasis upon all technical subjects and upon the general subjects of economics and English. Foreign language came next with the railways leading the demand.

Question 6.—The opinion of all, as to modification of standards for adjusting the college graduate to the organization, was against such a change by nearly 3 to 1.

Question 7.—Training in surveying beyond the needs of efficient work in surveying was not recognized by the Railways, as shown by a ratio of 1.7 to 1; by the Highways in the ratio of 1.2 to 1. The other groups were unanimously against it. The average negative opinion was 2 to 1.

Question 9.—As to the advantage derived from summer camp the Highways favor summer camp training 2 to 1, while the others oppose it by about the same margin. The total expression is slightly against it.

It is interesting, and perhaps significant, to note that the highways ask for greater emphasis on surveying than any of the other groups. The other groups seem willing to replace some of the present surveying by advanced technical and general subjects. The replies give strong emphasis to a thorough grasp of principles and to development of thought, interest and common sense, as being of greater importance than advanced subject matter.

Discussion of Question 8.

Replies to question 8 in regard to the economical emphasis on proficiency in different surveying operations are given in graphic form in Figs. 2, 3, 4 and 5. Although it is again

apparent that the highways are requesting more in surveying than the other organizations, there is a striking agreement in the proportion of emphasis given to the various operations. It is apparent that engineers in question 8 request further:

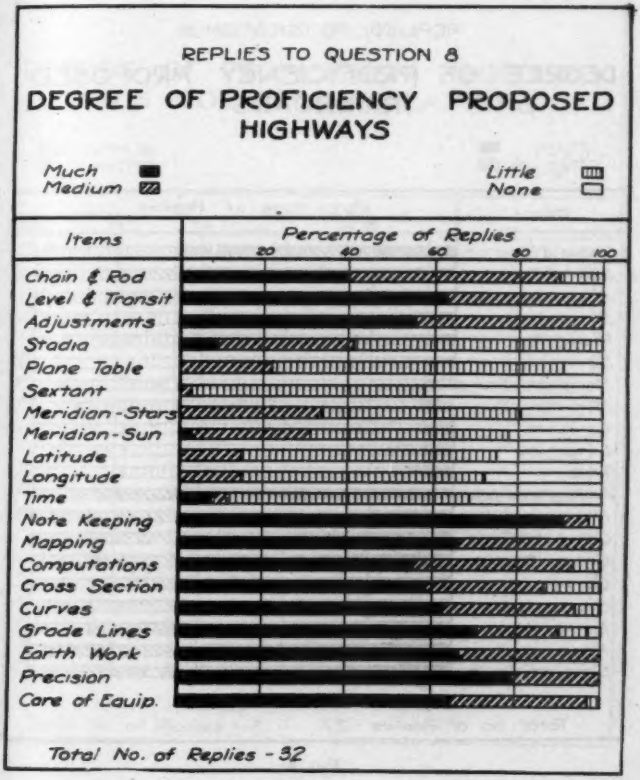


FIG. 2.

1. Very little work for stadia, plane table, sextant, meridian determination, latitude, longitude, and time determination and that for these items nothing more should be given than

sufficient theoretical class room work to enable the student to have a definite introduction to them and to know where to find further information concerning them.

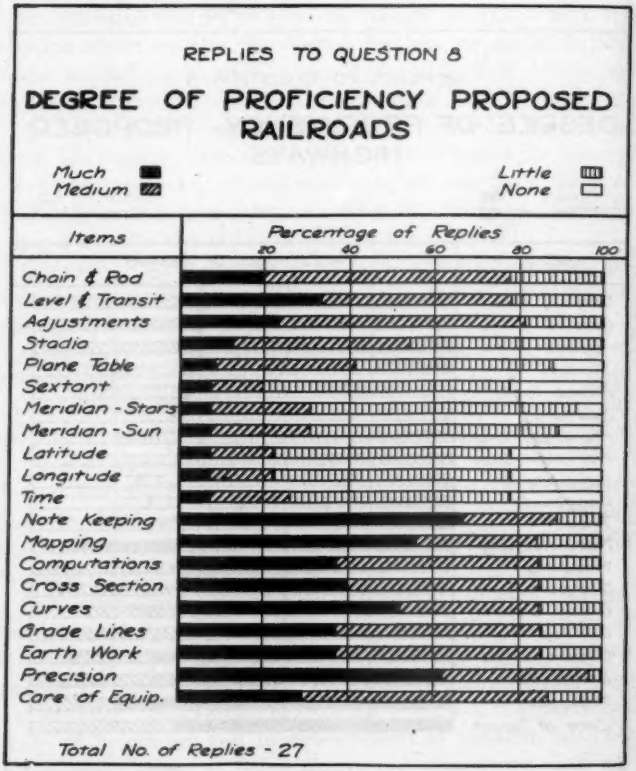


FIG. 3.

2. That notekeeping, as a matter of great importance, should be thoroughly taught; and that the proper degree of "precision" and the care of equipment should be emphasized.

3. That for highway and government work a specialized course in surveying is advisable in college; and

4. That for other work the theory of surveying with a little field work is preferable. Perhaps the general emphasis on note keeping and upon consistency in precision is a recogni-

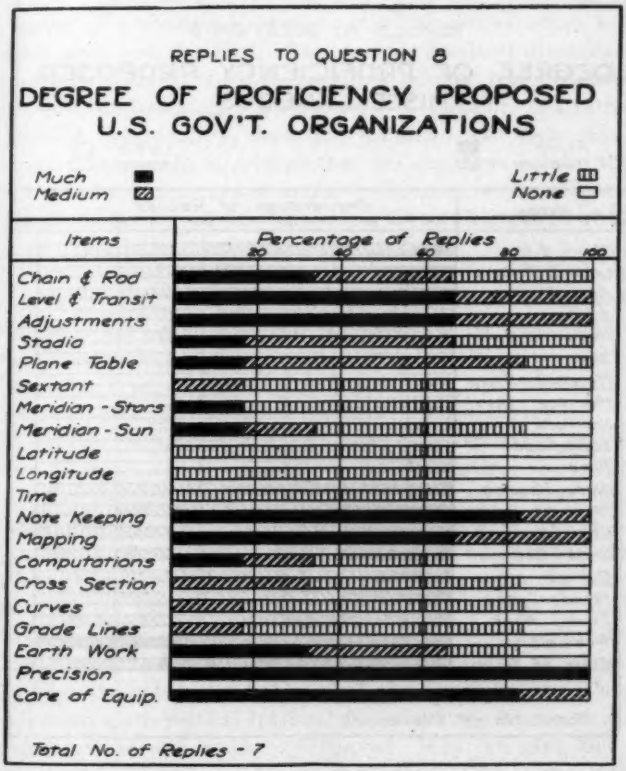


FIG. 4.

tion of the fact that these matters are of major importance in any line of work and that they may be developed in other subjects as well as in surveying. The committee thinks so, but at the same time recognizes the motivation factor which

is discussed later in the report as a reason for stressing these items in the early work in surveying.

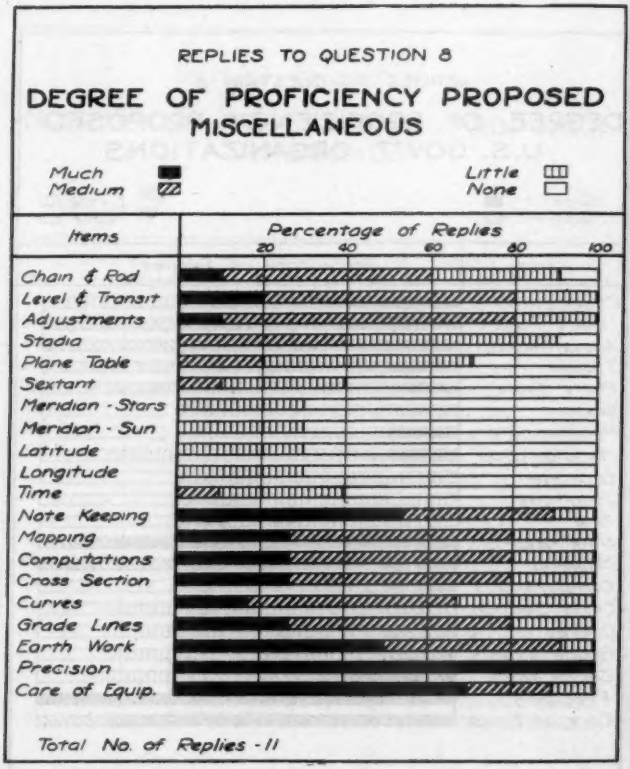


FIG. 5.

GENERAL DISCUSSION OF CURRICULUM

The Committee, in an attempt to focus attention upon the surveying content of a curriculum, refrained from asking questions which did not bear directly upon surveying. The replies, however, indicate that the engineers have a deep in-

terest in the curriculum in general and suggest that, along with a discussion of subject matter, they are also concerned with pedagogy and with the spirit of the training.

The Committee regrets that space does not permit the inclusion of a number of extracts from the letters which have been made and classified. They include excellent discussions, not only upon surveying, but upon general training, principles (fundamentals), development of thought, motivation, attitude, adaptability, business training and high school work. They make it evident that the engineers believe that all of these factors are of major importance in planning and in administering a course of study. As an illustration of the type of the letters, two references are given.

One engineer, in a railway field, asks for but little training in the kind of surveying which relates to the detail work of measuring angles, distances, etc., but asks for much emphasis on the ability to visualize the purpose of the survey and to secure and record quickly and accurately the information necessary to enable some one else to utilize the survey.

Another, in the highway field, gives emphasis to the motivation factor in surveying in the following words:

"The average youngster who starts out to seek a civil engineering degree feels that he must learn how to handle an engineer's transit, and until he does he has no patience with abstract mathematics, English, rhetoric, languages, nor many of the other general subjects which are included in an engineering course. Why not satisfy his curiosity regarding the handling of surveying instruments, the making of simple surveys, the running of levels, all of which require little if any advanced mathematical training and which the freshman can learn just as well as the sophomore? Why not give him a practical application of his trigonometry course in the form of surveying problems? Why not blunt the edge of his appetite for training in what he thinks an engineer is, and by doing so, stimulate in the process his imagination as to what an engineer in the broader sense should be? I firmly believe that if such a course of action were followed, there would be many less fatalities in our engineering freshmen, and further,

we would turn out at the end of four years a better class of engineers."

Conclusions

1. Opinion is about equally divided concerning the initial adaptability of the college man.

2. Opinion is unanimous that the college man finally adjusts himself so that he works to advantage in all engineering organizations.

3. Opinion is practically unanimous to the effect that sound fundamental training in surveying is essential as an integral part of the training of the civil engineer.

4. The men representing highway work alone, as a group, call for emphasis upon the technique of surveying when confronted by the fact that other desirable training must be sacrified in order to secure the emphasis upon technique.

5. The entire group by 34 to 33 opposes the reduction of surveying to provide for other subject matter. Outside of the highway field the expression is 28 to 15 the other way. The subject matter asked for in order of requests is economics, English, advanced structural and other advanced technical subjects. There is a small, but vigorous, call for foreign language, history, psychology, business and other subjects.

6. Three is a strong insistence that in all teaching much emphasis be placed upon the understanding of principles, development of thought, motivation, attitude and adaptability. Replies to question 7 give but mild encouragement to the suggestion that emphasis upon surveying is an economical manner of securing the development of these qualities.

7. The replies to question 8 concerning the proper emphasis upon different phases of surveying bring up a greater insistence for an understanding use of field data than upon the collection of the data. In the collection of data the chain, rod, level and transit are recognized as essential instruments. Astronomical observations and the use of stadia, plane table and sextant are given but little emphasis.

8. Opinion is evenly divided in regard to the value of summer camps of surveying. The replies indicate, however,

that the most of those who have definite knowledge of summer camp training regard it highly, without making it clear that they consider it an economical use of time.

9. The material in this report is presented, not with the thought that it should be literally followed in making or revising a curriculum, but with the belief that it will serve as a substantial background when thoughtfully applied to local conditions.

Respectfully submitted,

F. H. CONSTANT,
F. O. DUFOUR,
HORACE JUDD,
J. R. LATHAM,
LOUIS MITCHELL,
A. H. FULLER.

POWER

An Address to the Spring Meeting, Society for the Promotion of Engineering Education, Stevens Institute of Technology, April 27, 1929, by

GEO. A. ORROK

Consulting Engineer

The early poets and prophets have told us of the Golden Age when, as Kipling has said, men "drew their tucker somehow from the world and never wondered what they might have done." The garden was beautiful to the eye, the climate was good, food was to be had for the taking, and life was one long sweet dream. But the serpent entered Eden, man was driven forth to earn his bread by the sweat of his brow and thus, in his struggle for existence, began the first steps towards an engineering education. Weapons for defense, tools, fire, the domestication of animals, the ceramic and metallurgic arts, each represent long years of arduous labor stretching over uncounted æons of time till the invention of the wheel and axle on the plains of Sumer more than 6,000 years ago gave the first promise of the release of man from the curse pronounced at the flaming gates of Eden.

'Tis a far cry from Ur of the Chaldees and the Plains of Shinar to Auld Reekie and the epoch-making invention of Jamie Watt, but the development of Engineering Education, the making and use of engines, passing through 200 or more generations of human minds, evolved the steam engine in only a fraction of the time which had been expended in the invention of the wheel and axle. And Watt knew what he had invented. In petitioning King George he writes. "I have what all men desire, 'Power.'" And he did have it. The Boulton & Watt engines went all over the world spreading the gospel of Power. Stevenson, Stephens, Fulton, Bourne and many others, ending up with Corliss, applied the new power to transportation, the arts and manufactures.

But the period of development of Watt's invention was only a little over a century. In 1878 Edison invented the incandescent light which made possible the central station while Brown, Westinghouse, and Stanley introduced electric transmission making the use of power easy, universal and cheap. The opening of the new century saw the turbine superseding the clumsier reciprocating machinery of Watt and Corliss with the almost complete electric network covering the entire country.

In this country we are particularly fortunate. We have not been afraid of power, we have used it, we have applied it in every way that has been invented up to the present time. It has revolutionized our arts and manufactures, has given us many competing systems of transportation and communication. And our metallurgical arts have kept pace with the power demand. It has been conservatively estimated that we have in this country not less than 1,000,000,000 horse power of power-producing apparatus or roughly 8½ horse power per capita. Since a horse power is about equal to 6 man power, every man, woman and child may reckon on 50 man power of power producing apparatus which will do his work for him, when properly directed. The irrigation dykes and ditches of Sumer, laboriously built up with the forty-pound baskets of earth carried on the heads of the workmen may be contrasted with the all-American irrigation canal soon to be built near Yuma where each steam shovel, with its attendant trains, will move over 250 cubic yards of sand and rock per hour, transporting it 5 miles, and using the labor of only 8 men. The primitive blast furnaces of early times made iron at a labor cost of over 40,000 man hours per ton while our modern record furnace of the Pittsburgh district uses about two man hours per ton of pig iron.

Our civilization is a power civilization, and our prosperity is a power prosperity. That it is not due to our natural resources is obvious; Russia has a larger food producing power than the United States; Belgium, Germany, and Great Britain produce iron cheaper than we do; Chile produces fertilizer

and copper far below our costs. While we have more coal and oil reserves than the rest of the world, their resources are far from exhausted and are sufficient for their use for many years. We have no rubber and no tin. But we do know how to make power and, better than all, we know how to use it. And our engineering education has not been completed. Our early engineering and scientific schools only go back about eighty years, while I can remember the beginnings of most of them. This society whose object is the Promotion of Engineering Education is only thirty-six years old and its work is still in the formative stage. In 1850 men who knew "engines" were scarce, in 1900 the numbers had perhaps only quadrupled. To-day literally thousands of both men and women, boys and girls, know engines. They not alone know them but can make them work and at least a modicum can make repairs. Not alone do we perform miracles in the factory, producing a silk purse out of a sow's ear, but we produce miracles in the home in cooking, sweeping, washing and ironing. We talk to our friend over a thousand miles of wire and see his face at the same time. We listen to a concert in the Rose Bowl at Los Angeles or talk to Byrd in the fastnesses of the Antarctic.

I have said that your work has just begun for I believe that the Power civilization has come to stay. The world demands trained minds as well as trained hands. It demands men that know power, that believe in power, that can direct the use of power for the benefit of man, and that is the end and the beginning of an engineering education.

AERONAUTICAL ENGINEERING

BY FRED E. AYER

University of Akron, Akron, Ohio

The Navy's award to the Akron Goodyear Zeppelin Corporation of the contract for two dirigibles of six and one half million cubic feet capacity precipitated a flood of inquiries for information about what the University of Akron expected to offer in aeronautical education. An investigation of the present status of supply and demand in aeronautical education has convinced the writer that the present supply will satisfy the demand, especially of employers, for some years to come.

June 12, 1925, Mr. Daniel Guggenheim gave New York University $500,000 for a School of Aeronautics. Since then the Daniel Guggenheim Fund for the Promotion of Aeronautics has given a total of about $1,200,000 to five engineering colleges and one graduate business school. They are as follows:

California Institute of Technology,
Harvard University, Graduate School of Business,
Massachusetts Institute of Technology,
Leland Stanford University,
University of Michigan,
University of Washington.

In addition to the foregoing, catalogs from the following institutions announce complete courses in aeronautical engineering:

Armour Institute of Technology,
Carnegie Institute of Technology,
University of Detroit,
Purdue University,
University of Wichita.

The curriculum of aeronautical engineering as given by the colleges listed is essentially that of mechanical engineering

with options in aeronautic subjects varying from eight to twenty-five per cent of the total number of hours. The following taken from the catalog of the University of Washington is fairly typical of the aeronautic requirements of an under graduate course:

Aerodynamics	6 hrs.
Aerial Propulsion	6 hrs.
Aeronautical Design	6 hrs.
Airships	3 hrs.
Aerial Transportation	3 hrs.

The cost of adequate physical equipment for a department of aeronautical engineering as provided by the Guggenheim Fund seems to be about $300,000. A wind tunnel is a necessity and may be built for as little as $2,000, but one should probably estimate anywhere from $5,000 to $50,000.

Teaching personnel is not now easy to obtain, many of the present department heads being the product of European graduate schools. However, there is a fairly adequate supply of young graduates of some of the older and larger schools.

The demand for this type of engineering on the part of students seems, at first glance, to be stupendous. The red blood of adventure with which nature has filled the veins of every normal youth quickens when he contemplates the conquest of the third dimension. But when he finds that the path to aerial computations is beset by the same old rocky barriers of mathematics and science which prove so formidable in all other engineering curricula, his enthusiasm often wanes. Strict analysis of motives behind many inquiries concerning aeronautical training discloses quite a proportion who believe aerial transportation is "the coming thing" and, therefore, offers a short-cut to success.

The demand on the part of employers is not such as to lead us to believe that all our engineering colleges should hasten to organize aeronautical departments. In Bulletin No. 12 issued by the Guggenheim Fund, no attempt is made to forecast the future demand for such graduates, yet the following statement is indicative of the opinions of its directors:

"To other institutions which have sought the Fund's advice in establishing aeronautical engineering courses, it has been suggested that they give sufficient work in aeronautics to prepare the under-graduates for enrollment later in one of the six universities mentioned above."

Also in the same Bulletin we find the following:

"Although the National Advisory Committee for Aeronautics reports that it will need twenty aeronautical engineers a year, some of the large firms indicate a capacity to absorb only two or three"

The Chief Engineer of one large manufacturer of aircraft said to the writer:

"I can get along nicely with five or six good aeronautical engineers, but I need dozens of mechanical, structural, and production engineers."

It is far from the intention of this article to give the impression that this country does not need aeronautical engineering schools. Rather is it the hope to sound a warning lest we turn into those channels funds not needed there but sorely needed in the further development of engineering education already under way. We should be careful not to repeat the mistake made in mining engineering in which field we have over forty schools with a combined enrollment which could be well accommodated by a fourth or a third of that number. Also, we might ask ourselves the question "in a country which produces a large proportion of all the automobiles used in the world, what is the employer demand for automotive engineering graduates?"

Some of the larger schools benefiting from the Guggenheim Fund are already making their aeronautic departments into research and graduate schools and that seems to be the logical course to pursue. To prophesy is indeed dangerous, but the writer will hazard the prediction that aeronautic influence on undergraduate engineering curricula will be toward including aerodynamics as a part of, or following, hydraulics; extending internal combustion engines to include aircraft motors; adding problems in airplanes and dirigibles to structural design; and putting further instruction in aeronautics into the graduate school.

THE PRACTICAL IMPOSSIBILITIES OF "AN UNPRACTICAL EDUCATION"

A Reply

BY A. C. HOWELL

Associate Professor of English, University of North Carolina

Mr. J. C. Parker wants his son to have an unpractical education,[1] and I for one agree with him in many points regarding it. Shop practice, definite formulæ to learn for occasions which may never arise, and the hundred and one odds and ends which engage from time to time the more or less serious attention of curriculum committees are surely not worth the time and effort spent in studying them. But Mr. Parker is content, perhaps wisely, to stick to fairly general statements as to just what he means by practical and unpractical. He mentions the value of mathematics, of logic, perhaps of other studies. He talks of the "intellectual candor" which he wishes his son to develop, but I am not sure but that I see in his own remarks a catch-phrase for an evening's talk rather than an honest desire for an improvement in education. I wish he had been more specific, for the faculties of our schools of engineering are faced with specific problems of this sort every day. We cannot remain on the level of the general and abstract. We must decide whether Engineering 10 is to be taught or not, whether it is too practical, or not practical enough, and why. Let me be specific.

As a teacher of English I have been for many years torn between two opinions, two points of view in regard to the very matter that Mr. Parker refers to. Shall I teach practical or unpractical English? Some time ago a writer in this magazine published a paper entitled "English for Engineers? Never!" I read that paper with interest. Such an attitude as he had taken was wholly the reverse from my own. To

[1] "Wanted: An Uunpractical Education," by John C. Parker, *Journal of Engineering Education*, N. S., XIX, 9, pages 553–561.

adopt it might work me out of a job; for if there is to be no "English for Engineers," why have a professor of English for them. I worried about it a good deal. I went to the trouble of asking my classes to read the article and write their opinions regarding it. The papers are still knocking about in a drawer of my desk. But, as I might have expected, only the bolder said what they really thought; the clever ones ascertained my own attitude from the type of course I was giving, and perhaps did not show much "intellectual candor." So there the question remains. Some of their comments were interesting, though. They came from Seniors who had been through a course of "Bread and butter English," and almost without exception they preferred it.

II

My dilemma is still unsettled. Shall I teach practical English, or shall I teach unpractical English? Suppose, instead of my course in the writing of business letters, I substitute a less practical one in plain exposition. Suppose I teach the "comma fault" by means of the exercise books, refer the students to the excellent and polished exposition of Huxley and Tyndall, of Emerson and Matthew Arnold. Uundoubtedly the better ones would learn something of the art of writing, might catch the pleasure of expressing a thought eloquently as well as clearly, but what would they do when confronted with the real problem of writing a letter of application? And how popular would my course be? How much interest would my students take in it? My frank feeling is that a course in English has to stimulate interest in the students if it is to be successful in cultivating in them an intelligent reaction resulting in satisfactory work. My feeling is that the "comma fault," the rules for the paragraph and that dread trinity: unity, coherence, and emphasis take on real meaning if they are met in the forms in which the student is most likely to use them, in letters, in reports, in articles for the technical press. But this is practical work, and the cry now seems to be for unpractical education.

Let me put it another way. Here comes a student with the traditional attitude of engineers toward English. I teach him a thoroughly unpractical course in it; I harp on rules of grammar, of punctuation, of spelling; I assign him the traditional subjects for "themes," and use the inevitable books of "stimulating" essays; and what happens? He develops a perpetual hatred for the sight of pen and paper. The very thought of expressing himself in writing is abhorrent. He squeezes through the course with the least possible amount of work; he uses every subterfuge known to an ingenious college student to "put something over" on me, and thinks that it serves me right. Does he learn English? Not if he can help it. He has taken an "unpractical" course after Mr. Parker's own heart.

Actually, though, I take an entirely different attitude. I begin by stressing the importance of English to the engineer, and follow this with the statement that in my course we are going to study some of the practical forms that the engineer will be called upon to use when he goes out in to the world. Then, with the minimum of fuss about the rules of composition, we begin to write the sort of things that engineers are actually writing, practical letters, practical reports, practical articles. Are the facts and forms that he learns about writing letters "a little shop-worn," a little behind the practice of the business world when the student begins to use them in reality? Not if I am to judge by the horrible examples of letters and reports which my students pick up and send me by the dozens as material to be used in my course. Exactly the reverse is more than apt to be the case. So we go on writing letters of instruction, letters of explanation, letters of application, often from assignments based on real letters, meeting situations that have actually arisen. We study the technical magazines and write articles of each type which is to be found in them. We get up, edit and publish a little technical magazine of our own, which imitates its big brothers in everything except advertising and circulation. We are nothing if not practical.

We study the outstanding reports available in our engineer-

ing library and write sections of them, routine forms, and finally one really decent report, which is sometimes as much as forty or fifty typewritten pages in length and is frequently the equal of those which are done by men in the field.

And what is the result? The students take an interest in the course. They work on it willingly; they strive to outdo each other in the effectiveness of their papers; and they actually learn to write. Their only complaint is that the course works them too hard, not that they do not need it, or want it, or like it. Why? Because, being realists, they are convinced that it is worth their while, that they really do need to know something about English, that they really do want to be able to write a good letter, or a presentable report. It appeals to their practical good sense. And if I may judge from the comments of students who have already gone out, I believe they will not regret it in the future. I am not as old as Mr. Parker—my son is only three—but I venture to assert that if I were to send out a questionnaire in 1940 to my boys who took the course in 1925, they would still vote for practical English.

III

Now may I theorize a bit about this matter of a practical education, of practical courses. In theory the unpractical education looks beautiful, but it neglects several factors which the educator who is on his job cannot afford to miss.

In the first place, the educator cannot forget that for the great majority of people education is a tool. It would be useless for him to fashion for his client a fiddle-bow when the client wanted and needed a hack-saw. It is all very well to talk of culture in glowing terms, and of the knowledge of how to be happy in poverty; but that is not the reason why students overflow our colleges. They come to learn how to earn a livelihood, to learn a profession, and it is the duty of the educator to give them as much training as he can toward this end. Opinions may and do differ as to how this may best be done, but the clients seem to think that it is best done by teaching them to do the things which the men of their pro-

fession actually are called upon to do. So long as that condition obtains, the educator who desires to hold his job, the president who desires to have a numerous and intelligent student body is practically compelled to yield to this opinion. It is all very well to talk of unpractical subjects; the fact remains that they will not meet the needs of a practical world. And the clients, being realists, know it.

If we define practical as "of or pertaining to practice" and a practical education as one which attempts to simulate in course and laboratory the methods and procedure followed in the profession, we find that the very most practical course for engineers is the post-graduate course offered by the very industry of which Mr. Parker is a representative—the courses offered to graduates by several of the large electrical concerns. Do they demand for the men they invite to enroll in these courses, graduates of the so-called arts course, Mr. Parker's "unpractical education?" Not at all! They demand pretty rigid training of a practical nature.

The Board of Investigation and Coordination of this society recently submitted a report on a suggested engineering curriculum, and it is worthy of note that this report recommended as many "practical" courses as had been in the previous curricula of engineering schools. And on this board were representatives of the very industry Mr. Parker represents. They evidently knew what they wanted. One wonders just how sincere these executives are who plead for one thing and propose another, who talk about "unpractical education" and demand a practical one.

And just what does Mr. Parker mean by practical, and what by unpractical? Can he draw the line between the two? It is so difficult to do that few courses in the average engineering curriculum can be definitely placed on one side of the fence or the other. Most of them straddle. What is practice but theory in action, or theory but generalized practice? A good course should have both in it. Even Mr. Parker's beloved pure mathematics becomes mighty practical when applied to a problem in hydraulics or dynamo design. The

"beautiful" hypothesis of the planetary circulation of the atmosphere is no substitute for knowing where and how to get rainfall records. And examples might be multiplied. Moreover, theory pure and simple means nothing to a student engineer unless it is applied in practice. It does not stick in his mind beyond the final examination. In mapping out a course the educator must think of these things. He wants his proteges to learn, and he has discovered that by mingling practical applications with his theories, he can make them stick.

And finally the educator must consider the matter of student interest. The engineer is a realist, and he wants to know why he is doing this or that. If he knows why, and can understand the practical value of a course, he goes to and learns it with a will. He wants to learn all he can about it. His interest in stimulated. Such a state of affairs is the desideratum of every professor for every course. To teach a class so stimulated is a joy, and to see the results of such teaching, five, ten, or twenty years later is to be wholly convinced of the necessity of doing every thing short of vaudeville stunts to stimulate such interest. By all means, then let the educator make his courses practical, let theory be slipped in when and where it can, but let the course arouse in the students a desire to master it, to put it to work for themselves.

No, what Mr. Parker really wants, and what he actually means, is not an "unpractical education" but a practical training superposed upon a broad educational and cultural background. This has been for many years the desideratum of engineering educators; and it is a sane and wholesome one. If, moreover, the engineering profession continues to go in the direction in which it is now headed, it seems to be the only sound education for it. Such a curriculum would include courses in philosophy and logic, in sociology and literature, to mention only a few "unpractical" subjects. To complete such a curriculum would require from five to seven years. And other professions, law, medicine and the ministry, have gradually demanded this much time in college and university

of their graduates. But to such a proposal the Board of Investigation and Coordination, with an ear to the demands of the great industries which absorb cadet engineers, has given a more or less emphatic negative. And so the stereotyped four-year curriculum is likely to remain; for it Mr. Parker must blame to some extent the leaders of his own industry.

OBJECTIVE TYPE TESTS IN ENGINEERING DRAWING AND DESCRIPTIVE GEOMETRY *

A Summary of the Research in Drawing and Descriptive Geometry at Missouri School of Mines, for the Year 1927–28

BY CLAIR V. MANN

Professor and Head, Department of Engineering Drawing

Some years ago I propounded to myself the question as to whether there existed in the field of Engineering Drawing and its teaching a field worthy of research and the expenditure of a lifetime of effort. I was somewhat disturbed by the conclusions I then reached. The field seemed to offer so little of promise that I was on the point of developing an "inferiority" complex by reason of my connection with a "Drawing Department." Today it is all changed. There appears to be unbounded opportunity for worthwhile research in teaching and testing in this field. How has this come to pass?

I confess that a great interest was aroused by participation in the S. P. E. E. investigation, as chairman of our local Committee on Engineering Education, and through membership on the S. P. E. E. Council. But the inner gate to this field of research opened when our institution decided, beginning with the 1927 fall term, to adopt a program designed to discover the particularly gifted students in the freshman class, so as to provide them with the greatest possible opportunity.

This program involved segregation and sectioning of students on the basis of ability, and the establishment of three sections, or levels of instruction, suited to the levels of student ability found—superior, medium, and lowest. These levels of ability were to be determined by administration of the

* Presented at the Conference on Drawing, at the University of North Carolina, June, 1928.

Iowa Placement Examinations in Chemistry, English, and Mathematics (CA-1, CT-1, EA-1, ET-1, MA-1, MT-1). Sophomores in physics were also to be sectioned, using Iowa tests (PA-1, PT-1).

Comparison of drawing grades with grades in other Freshman subjects revealed no particular correlation—and there seemed to be no adequate reason for expecting such a correlation. It seemed that here was the doorway to our field of research, and so it proved to be. I decided to construct a placement examination in engineering drawing, to be administered in parallel with the other Iowa tests, and in general character the same as the Iowa tests. The faculty approved the arrangement.

Some two weeks of planning and reading sufficed to produce the test, copies of which are at your disposal for examination. You may wonder where the connection is to be found between this test and the process of mechanical drawing. My answer is that one essential requirement of a placement test is that it shall be so constructed as to permit of a high degree of objective scoring. By this is meant that there must be but one possible answer to each question. To that end it is necessary to include a large number of short, concise statements or questions, each requiring as an answer only a word or two, or a scoring mark of some kind. This general requirement at once ruled out a whole class of sketches and drawing that might otherwise have been included, owing to the fact that such materials are incapable of strictly objective scoring by known methods. The question now was, "What sort of material *can* be used in such a test?"

It was decided that the field of plane and solid geometry could supply a considerable part of the necessary objective type material for an aptitude test for Engineering Drawing, since knowledge of geometry is a prerequisite to any measurable success in drawing. Parts 1, 2, 3, and 7 of this particular test consist of materials from this field. Part 1 covers visual familiarity with the common figures and solids of geometry. The true-false questions of Part 2 cover the abstract prin-

ciples of plane geometry. Part 3 tests aptitude and experience in measurement with the unaided eye; and part 7 tests ability to make the simpler geometric constructions.

To the above material there were added, in Parts 4 and 6, comprehension tests in the reading of literature of Engineering Drawing. Part 5 was included to test student familiarity with the various materials and instruments of mechanical drawing. All these test parts were capable of objective scoring—some, however, to a greater degree than others.

As a further experimental part of the test (Part A), the student was asked for specific information concerning the extent of his training in plane and solid geometry; his past experiences, if any, either in drawing or in engineering work; and the nature of his interest in the drawing courses. The student was required to print this information in his best style, and other score points were allotted for the quality of this printing, subjectively scored or rated.

Appropriate keys and directions for scoring and administering were constructed, and eight hundred copies of the tests were then printed. The total cost of printing, including the making of necessary zinc plates and half-tone cuts, was thirty cents per copy. The test contains eight pages of test material, together with the cover sheets and manual of instructions (a single sheet).

The test was administered by the Department of Engineering Drawing to 162 Freshmen on September 13, 1927. The resulting scores are presented as a "histogram" in Table 1.[1]

A test of the effectiveness of our placement examination in drawing would be furnished by comparison of scores made in it with first-term grades in drawing. It seemed quite necessary therefore to make those term grades as accurate and reliable as possible. This required close uniformity of grading

[1] Note: Accompanying the reading of this paper at Chapel Hill, a number of other charts and tables were exhibited, which, by reason of their size, number, and cost to reproduce, cannot be included here. There were also exhibited all the 2,500 lettering cards collected from the fifty engineering colleges, to which reference is made later in the article.

TABLE I

DEPARTMENT OF ENGINEERING DRAWING
MISSOURI SCHOOL OF MINES

Graphic Exhibition of Score Distribution in Original Placement Examination in Engineering Drawing
Administered September 13, 1927.
Maximum Possible Score, 200. Minimum Possible Score, 0.
Study by C. V. Mann.

					70					
					70					
					70					
					70				Standard Deviation	
					70	81			21.0	
					70	81				
					70	81				
					71	81				
					71	82				
					71	82				
					72	82				
					72	82				
				61	72	83				
				61	73	83				
				61	73	83				
				61	74	84	90			
			50	62	74	85	90			
			51	63	74	85	91			
		40	51	63	74	85	91			
		41	51	64	74	85	91			
		42	51	65	74	85	93			
		42	52	65	75	85	93	100		
		42	53	65	76	86	94	101		
		43	54	66	77	86	95	102		
		43	54	66	77	86	96	102		
		45	56	66	77	86	96	103		
	30	45	57	66	77	86	96	104	110	
	30	45	57	66	78	87	97	104	112	
	32	46	58	68	78	87	97	105	113	
	35	46	58	68	78	87	98	107	113	
	39	46	59	69	79	87	98	108	115	
	39	48	59	69	79	88	98	108	116	123
20	39	49	59	69	79	89	98	109	119	127

DISTRIBUTION OF SCORES OF 162 FRESHMEN. SECTIONS A, B, AND T.

by all the members of the staff. There was small hope of securing this result except through standardized departmental quizzes and final examinations, all embodying the principle of objective marking or scoring. This practise was adopted. Each instructor was given an opportunity to cooperate in the construction of the three term quizzes. Each

supplied lists of questions, and each had the privilege of objecting to any question he considered unfair to his section. Such questions were eliminated.

All these first term quizzes consisted of "single" true-false recognition type questions, or "recall" question types requiring one or two word responses. The tests were typed and mimeographed by our departmental stenographer, and all necessary blueprinting and drawing done by our departmental draftsman. The final term grades were made up by weighting daily practise plates, subjectively graded, as one third of the final grade; objective term quizzes as one third; and the objective final examination as one-third.

The final examination, or "Training Test" as we call it, represented our most advanced experimental objective type test in engineering drawing. It covered first term Engineering Drawing in a fairly comprehensive manner. Part 1 consisted of the execution of a card of freehand engineering lettering, done in India ink, on forms identical with those we later sent out to the fifty engineering colleges, as I shall later explain. Part 2 tested the student's ability to select identical letter forms from an exercise containing one pattern letter and a group of varying forms of that letter. Part 3 was a battery of true-false questions covering principles of the course. Parts 4 to 8 included a large number of small drawn figures, or "layouts," for each of which there was a set of objective questions, requiring some kind of a score mark or single word response. Parts 9 to 13 included partially completed drawings of machine parts, requiring certain definite lines to be drawn for their completion. Keys were made whereby these parts could be quite objectively scored. The administration of this test was controlled by an estimated time schedule, and proved to be an entire success. The possible score range was from 0 to 300, while the lowest and highest scores actually made were 54 and 199. Converted into "per cent grades," these scores were, respectively, 44 per cent and 99 per cent.

In setting up the levels of instruction, we tried the plan of adopting texts written by different authors in each of the

three levels of instruction. "Engineering Drawing," by French, was used at the highest level; "Jordan and Hoelscher" at the medium level; and "Svensen" for the lower level. We feel that a mistake was made in not supplying all sections with the same textbook, and the plan will not be tried again. In addition to these features, the upper sections were given more plates, and of a character much in advance of the lower sections. The common departmental quizzes showed us at all times the relative accomplishments in the three groups. The work of the upper sections was enriched by short orientation lectures on every appropriate occasion, pointing out practical applications of drafting work in engineering practise. We have come to feel that the Department of Engineering Drawing, meeting as it does the Freshman students in practically their first real engineering course, has a particularly fine opportunity for such orientation work. This phase of instruction enlivened and to a large degree intensified interest in all work of the course.

TABLE 2

DEPARTMENT OF ENGINEERING DRAWING,
MISSOURI SCHOOL OF MINES, ROLLA

Distribution of Term Grades in Drawing 213 in the Several Fifths of the Class of 1931 (Freshmen, Fall of 1927)

List of grades made in first term course. Fifths are determined on the basis of scores made in the original administration of the aptitude test in Engineering Drawing.

	"E" Excellent	"S" Superior	"M" Mediocre	"I" Inferior	"F" Failures	Drop	Pass	Fail	Total
Highest 5th.....	1	18	9	5	0	0	33	0	33
Second 5th.....	3	4	19	4	1	1	30	1	32
Third 5th.....	0	5	13	8	1	5	26	1	32
Fourth 5th.....	0	1	9	13	4	5	23	4	32
Lowest 5th.....	0	0	3	15	10	5	18	10	33
						16 10%	130 80%	16 10%	162 100%

Equation between letter and per cent grades:
E = 95–100%; S = 85–94%; M = 75–84%; I = 65–74%; F = 65–0%, failure.

Table 2 shows distribution of the first term grades accorded in Engineering Drawing. These are distributed among the five "fifths" of the class, highest to lowest, with scores on the Placement Examination taken as the "criterion." The "Pearson product-moment" correlation coefficient obtained by comparing scores on the Placement Examination with term grades in drawing was .626, a very satisfactory result.

Sectioning of classes for the second term course— descriptive geometry—was organized on the basis of first term grades in Engineering Drawing. In setting up the three levels of instruction, a single text—"Descriptive Geometry," by Schumann—was chosen for all sections. The section of low ability was required to cover the minimum permissible course content, determined by conference of the staff. Many text articles were omitted in the lower level of instruction, while in the high level the section covered practically all the text, and received in addition much material involving application of descriptive geometry to mine engineering and mining geology. Professors from the departments of Mining and Geology were invited into the class for lectures in which they pointed out to the descriptive geometry students the fact that the work being done in the class had most practical uses in their fields. All these devices proved to be immensely stimulating to the class, and relieved the monotony of daily practise plates. The plates involving geologic outcrop lines, and "hole drilling" through varying geologic formations, elicited the greatest student interest. Some of this work, executed in color, is indeed handsome.

A series of five objective type term quizzes, comprising 300 "items" or score questions each, covered the descriptive geometry work of this second term. Each of these quizzes was divided into two "Parts," each contributing 150 score points. The first half was usually made up of "single" or "double" true-false questions, and the second half of problems, or short objective type questions related to accompanying problem layouts. The final examination was of this latter character. Possible score ranges were from 0 to 300.

These test types are now regarded by our staff as quite highly reliable and satisfactory. The range of test reliability coefficients, obtained from self-correlation of "chance halves" by use of the techniques of statistical method, has been from .80 to .95, the latter result being for the final examination in descriptive geometry. The reliability coefficient has increased in proportion to our experiences in constructing and administering the tests, and with the elimination of question types giving poor results.[2]

Most of the quizzes could be completed by the student in 1½ hours, while 3 hours was, in most cases, ample time for the final descriptive geometry examination. The speed, thoroughness of sampling of course materials, certainty and objectivity of grading, the application of the principle of "stencil scoring," and thus the ability to make free use of student assistant help, are the outstanding features of these tests, aside from the high reliability of the later test forms.

The correlation found between grades in first term drawing and second term descriptive geometry (Pearson product-movement coefficient) in this case is .672—slightly higher than between Placement Test and first term grades.

All of this work opened up numberless other doorways to research. What had been the character of our past departmental practises in grading, under the subjective system of quiz grading? Without making extended comment, the answer may be noted by inspection of Figures 6 to 10 inclusive, the end result of the special study made.[3]

Such conditions would in all probability be found in most college departments where subjective grading practise is the

[2] Since the preparation of this article, the writer has been on leave of absence from Missouri School of Mines, in order to study the whole series of tests constructed intensively. This work has been done at the University of Iowa. Results will be published in a two volume doctoral dissertation, one of which contains the study of the twenty-three test units constructed, and the other a file of eleven representative tests. All test units from No. 15 on have proved to have coefficients of reliability of .870 or better, and the best test has parts which have given such coefficients as high as .970.

[3] Lack of space prevents inclusion of this set of charts.

TABLE 3

SCHOOLS PARTICIPATING IN LETTERING TEST

No.	Name (Abbreviated)	Returned Cards
1	Mo. School of Mines	142
2	Alabama Poly. Inst.	Did not participate
3	Arizona, Univ. of	47
4	Arkansas, Univ.	50
5	Brooklyn Poly. Inst.	32
6	Calif. Inst. Tech.	√
7	Calif., Univ.	Had no Dept. Eng. Draw. Did not participate
8	Case School Ap. Sc.	√
9	Carnegie Inst. Tech.	√
10	Cincinnati, Univ.	√
11	Colo. Sch. Mines	√
12	Colorado, Univ.	Did not participate
13	Columbia University	√
14	Cornell University	√
15	Dartmouth College	Did not participate
16	Florida, Univ. of	√
17	Georgia School Tech.	Thought enterprise useless. Did not participate
18	Harvard Univ.	√
19	Idaho, Univ.	√
20	Illinois, Univ.	√
21	Iowa, Univ.	√
22	Johns Hopkins Univ.	Did not participate
23	Kansas, Univ.	√
24	Lehigh Univ.	√
25	Maine, Univ.	√
26	Kan. State Ag. Coll.	√
27	Michigan, Univ.	√
28	Minnesota, Univ.	√
29	M.I.T.	Reported no time to give to project.
30	Montana, Univ., Mines	√
31	Nebraska, Univ.	√
32	New Mexico, Univ.	√
33	New York Univ.	√
34	Northwestern Univ.	√
35	Ohio State Univ.	√
36	Oklahoma, Univ.	√
37	Penn. State College	√
38	Pittsburgh, Univ.	√
39	Purdue Univ.	√
40	Stanford Univ.	√
41	Swarthmore	√
42	Texas College Tech.	√
43	Tufts College	√
44	Tulane U. of La.	√
45	Virginia Poly. Inst.	√
46	Wash. Univ., St. Louis	√
47	Washington State Univ.	√
48	Wisconsin Univ.	√
49	Yale University	√
50	Vanderbilt Univ.	√
51	North Carolina Univ.	Did not participate.

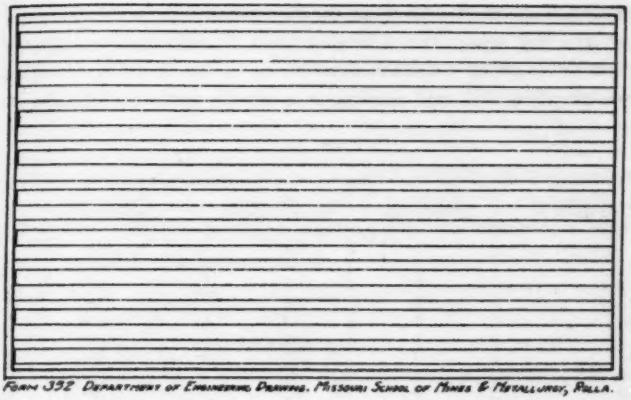
rule, if studies like the one we carried out were to be made. In fact, this is a general conclusion that has been widely arrived at, wherever such studies have been made. Many writers point this out. Here is a much needed field for investigation and improvement. We may note, too, in passing, that the "letter grade" is inadequate for purposes of statistical study and correlation, as we found in our own work. Our system of "objective" scoring and grading has eliminated this unscientific practise in our department.

A further line of activity which suggested itself as a result of our testing program was an inquiry into the manner in which engineering lettering is being taught in the engineering colleges. How did the quality of lettering done by our students compare with that in the leading engineering colleges of the country?

To gain information on this subject, we sent out a lettering test and 2,500 blank cards (Part 1, taken from our Training Test for Engineering Drawing) to fifty representative engineering schools of the country We asked the submission of 50 sample cards of student lettering, all levels of quality included, in order that we might make this study. We secured generous response. Table 3 exhibits the list of institutions participating.

The cards collected indicate *wide* differences in the relative importance being placed upon the teaching of lettering, the character of the letter forms being taught, and the standards of grading in general. A single card of lettering such as is shown in Fig. 1 was sent out to each of these institutions, with the request that it be rated or "graded" by the staff of each drawing department. The returns made are shown in Table 4. Eighty-nine instructors graded this same card, and their grades ranged all the way from 75 to 95, as shown by the table. These data are of interest in that they suggest how widely the standards of grading vary as between some of our most outstanding engineering colleges.

The cards as a whole suggest that many factors must be considered in grading a lettering test. Manifestly there are



Training Test in General Engineering Drawing. Part 1.
FIG. 1. Blank Card Supplied Student for Lettering Test
This exercise is to count as the first twenty-five items of the Test
Items 1 to 25, inclusive.

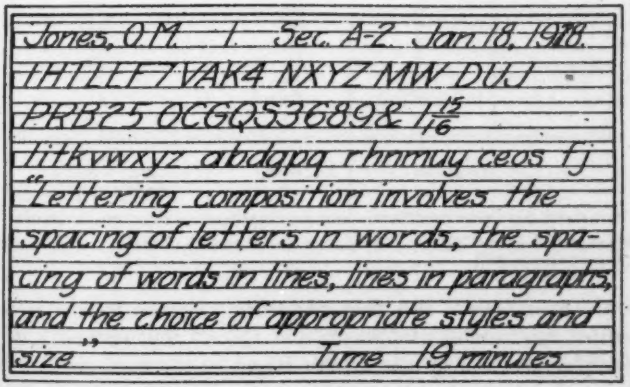

Jones, O M. 1 Sec. A-2. Jan 18, 1918.
IHILLF7VAK4 NXYZ MW DUJ
PRB25 OCGQS3689& 1 15/16
litkvwxyz abdgpq rhnmuy ceos fj
"Lettering composition involves the
spacing of letters in words, the spa-
cing of words in lines, lines in paragraphs,
and the choice of appropriate styles and
size" Time 19 minutes.

FIG. 2. Sample of Work Expected of Student. Cards 3" x 5".
Possible Part Scores:
Maximum, 25.
Minimum, 0.
Score determined by "ratings" of 3 or more instructors.
Actual Part Score.....

two quite distinct sets of principles which will form the basis for grading scales for lettering: (1) "absolute perfection," with little or no consideration given to the time required to produce the card, and scoring to be on the basis of "good gen-

TABLE 4

Number of Institution	Number of Instructors	Av. Institutional Grade on Card	Sum of grades of all Instrs.
1	4	92	368
47	2	92	194
48	6	88	528
13	3	75	225
16	2	92	194
3	1	88	88
45	3	95	285
39	8	93	744
R	3	87	261
44	2	95	190
10	7	87	609
20	10	91.9	919
43	2	90	180
31	3	93	279
5	1	85	85
36	2	90 (B)	180
37	6	96	576
25	3	96	288
24	4	85	340
8	3	95	285
6	3	85 (2)	255
21	1	88	88
29	8	79.4	635
11	2	75	150
24	Totals 89	Av. 88.8	7,946 Av. 89.28 for the 89 Instrs.

Mean grade, 24 institutions, 88.8%; for 89 instructors, 89.28%. Median, for 24 institutions, 90%.

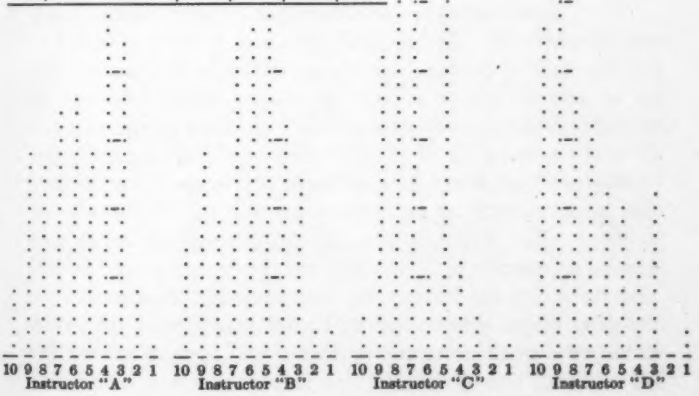
eral appearance," and that perfection attained by the most skilled commercial draftsmen; and (2) on the basis of a detailed analysis of all the defects found on the card, measured in as objective a way as possible, and with a definite requirement in the way of a time limit for production of the completed card. Of the two methods, the first, modified so as to include a reasonable time limit, will likely be most acceptable

for the present. The second method has great possibilities, and will be used for the basis of a truly scientific testing scale for measuring proficiency in engineering lettering. Several scales of the first type have already been devised, but seem not to have found wide general use. Among them may be mentioned one constructed by Harold Rugg.

TABLE 5

TABLE SHOWING DISTRIBUTION OF FOUR INSTRUCTORS' RATINGS ON PROFICIENCY OF LETTERING DONE BY 142 STUDENTS

Score	Grade, %	Instructors, and Number of Their Ratings (Frequency) Falling in Each Score Interval			
		Instr. "A"	Instr. "B"	Instr. "C"	Instr. "D"
1	96.5–100	1	1	1	2
2	92.5–96.5	5	2	1	0
3	87.5–92.5	23	13	3	12
4	82.5–87.5	25	17	17	7
5	77.5–82.5	15	25	28	11
6	72.5–77.5	19	24	6	12
7	67.5–72.5	18	23	37	17
8	(Pass) 59.5–67.5	14	10	32	19
9	(Fail) 40.5–59.5	15	15	22	34
10	0–40.5	5	8	3	24



In conclusion, we think our work for the past year has amply demonstrated that a rich field for research exists in the field of engineernig drawing. We have learned, to our own

entire satisfaction, that objective testing procedures can be used with great advantage in this field, and are immensely more reliable and superior to the old subjective system. And if the application of objective type tests can be made in the case of such subjects as engineering drawing and descriptive geometry, then they are applicable in practically the whole range of studies included in the engineering curriculum, for in no subject is the application of the principles of objective testing more difficult than in engineering drawing.

SECTIONS AND BRANCHES

The **Case** chapter of the Society for the Promotion of Engineering Education elected officers for the coming year following a dinner of the chapter in the Case Club.

Professor H. M. Boylston was elected chairman; Mr. C. W. Wallace, secretary; Professors Zimmers, Carlton and Hoover, program committee.

Following the election of officers, Professor Plummer of the Civil Engineering department of Case School, gave an address on Zeppelin Hangar Design and proposed Lorain Central Bridge Design.

The **Colorado Branch** held its annual autumn reception for all members of the engineering faculty and their families at four o'clock, October 17, in Engineering Building No. 1. The Library was used as a dancehall. For those who did not dance, other forms of entertainment were provided.

The next meeting was held February 12. An oyster supper was served first; then the members assembled to hear a report on the advisability of adding courses in liberal arts to the engineering curriculum. The investigation committee, following the recommendations of the S. P. E. E., proposed that fifteen hours of approved electives (six hours in *Principles of Economics*) be put into the curriculum by eliminating or cutting down engineering courses now required. The heads of the various departments were allowed five minutes to present their views and explain how the plan would affect their courses. Every one agreed that the additional courses would be splendid for the student, but a heated discussion arose whether or not fifteen hours of liberal arts courses would decrease the efficiency of the graduate as a technically trained engineer. The members, by vote, agreed that the investigation committee should proceed to arrange a plan for incorporating the fifteen hours into the engineering curriculum.

The third meeting was held on April 10, at which time Reverend J. J. Donnelly of the St. Francis De Sales School, Denver, Colorado, presented four of his pupils, two of them in the second grade and the other two in the seventh grade. Father Donnelly demonstrated what he was doing to teach arithmetic and algebra in the elementary grades. The performance of his pupils was astonishing. One of the girls in the second grade did board work in which she solved quadratic equations by completing the square, or by other formula; and she also solved simultaneous equations. One of the older girls (12 years of age) had covered the first year of college algebra thoroughly. The work of the pupils was truly remarkable.

Father Donnelly stated that his achievements were due to his methods of cultivating interest, concentration, perception, and retention. His methods offer great possibilities, and members of the faculty are going to investigate them. Father Donnelly is very unassuming regarding his "find," but there is no doubt that his efforts are going to receive recognition. He has published only one pamphlet about his work: "Teachers' Manual for the Presentation of Number in the First and Second Grades."

The activities of the Colorado Branch for this school year will be concluded by a picnic, which will be held the latter part of the spring quarter for members of the faculty and their families.

COLLEGE NOTES

Massachusetts Institute of Technology.—Fully twenty-five thousand visitors inspected the Institute at the Annual Open House, April 27. The Nautical Museum attracted special attention with its unusual exhibition of ships, including war vessels, merchant vessels and yachts, a complete radio direction-finder and automatic sounding devices. The Dramashop presented two plays for visitors at the Walker Memorial. During the afternoon the Crew race with Princeton took place on the Charles River Basin. In the evening the Institute buildings were flood-lighted by powerful searchlights located on the Boston side of the Charles River Esplanade.

To meet the ever-increasing demand for scientifically-trained Sanitary Engineers, the Institute next fall will offer a new course, called "Public Health Engineering." The curriculum of this course is unique in the scope of its application, ranging as it does from the fundamentals of pure milk control, to the design of playgrounds and parks, and is practically the first course to be offered in this country for the training of engineers for the specific task of the scientific sanitation of our rapidly growing cities.

The student branch of the American Institute of Electrical Engineers for its May meeting inaugurated a new type of technical session. The members of this Society gathered for lunch in Walker Memorial at 12 o'clock. After the lunch an hour and a half was devoted to the presentation and discussion of two original student papers on the Gas-Electric Drive for Automobiles. The benefits of this type of meeting, where the students do the presiding, present the papers, and take part in the discussion, are greater than those derived from any other type of meeting. Apparently, the problem of ensuring the attendance has been successfully solved by having the session immediately following a well-planned luncheon.

BOOK REVIEW

Production Planning, its Engineering Elements. PROFESSOR J. W. HALLOCK, M.E., University of Pittsburgh. Ronald Press Company, New York, 1929, pages V and 172, index and Bibliography.

This book is written first as a textbook, and second for reference use. As the sub-title indicates, it presents the subject from a distinctly engineering angle, using quantitative facts and working formulas to develop the decisions and procedures sought.

The case data used throughout are based on the manufacture of iron body gate valves. In one way this is a limitation, but it has the distinct merit, on the other hand, of giving enough material for a fairly complete picture of procedure as applied to a typical machine shop product.

The analysis covers raw material required, the time necessary to secure it, the manufacturing equipment and time required for machining, the balance between quality and quantity, and methods of controlling production. Formulas and charts are given for analyzing the power, feeds, and capacity of machines, the economics of jigs, fixtures and materials handling apparatus, and for determining the economic lot sizes for production and for stores.

An appendix gives a useful series of problems in planning and production control, covering a line of iron body globe- and gate-valves, with the necessary drawings giving the data required for the work. A brief but representative bibliography furnishes access to other books in the production control field for those who wish to carry the subject further.

The matter which is presented contains little that is new, but it is pertinent, clear and teachable, and the book will be very helpful in presenting problems which can be evaluated quantitatively as are the other problems in the older fields of engineering.

J. W. ROE.

ERRATA

The following footnote was omitted from the April JOURNAL, page 790:

"This talk is based to a considerable extent upon John Tyndall's book, 'Faraday as a Discoverer.'"